STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
ENERGY FACILITY SITING BOARD

In re The Narragansett Electric Company	:	
d/b/a National Grid	:	Docket No. SB-2016-01
(Aquidneck Island Reliability Project)	:	

Testimony of

William H. Bailey, Ph.D.

March 3, 2017

TESTIMONY OF WILLIAM H. BAILEY, PH.D.

Introduction

Q. Please state your full name and business address.

A. My name is William H. Bailey. My business address is 17000 Science Drive, Suite 200, Bowie, MD.

Q. By whom are you employed and in what capacity?

A. I am a Principal Scientist in the Health Sciences practice at Exponent, Inc. ("Exponent"). I am also a visiting research scientist at the Weill Cornell University Medical College in New York.

Q. What is Exponent?

A. Exponent is a scientific and engineering firm comprised of scientists, physicians, engineers, and regulatory professionals that perform in-depth scientific research and analysis in over 90 scientific and engineering disciplines. Within Exponent, the scientists of the Health Sciences practice have training and expertise in epidemiology, cell and cancer biology, medicine, public health, physiology and pharmacology, and toxicology.

Q. Please describe your current responsibilities.

A. I work primarily in the assessment of environmental and occupational exposures and their relationship to health. My work involves reviewing, analyzing, and conducting research. One of the areas in which I have done a great deal of work relates to assessments of the electric and magnetic fields ("EMF") associated with electrical facilities, such as transmission lines, substations, and electrified railroad lines.

Educational Background and Experience

Q. Please describe your educational background, research experience, and professional degrees you have been awarded.

A. I earned a Ph.D. in neuropsychology from the City University of New York. My education includes a B.A. from Dartmouth College in 1966 and an MBA from the University of Chicago, awarded in 1969. Since 1986, I have been a visiting research scientist at the Cornell University Medical College. I also have been a visiting lecturer at Rutgers University, the University of Texas (San Antonio), and the Harvard School of Public Health. From 1983 through 1987, I was head of the Laboratory of Neuropharmacology and Environmental Toxicology at the New York State Institute for Basic Research. For the nine previous years, I was an Assistant Professor and Postdoctoral Fellow in Neurochemistry at The Rockefeller University.

Q. Have you served as a reviewer and scientific advisor on health-related issues for government or scientific agencies? If so, please describe.

A. Yes. I have reviewed research for the National Institutes of Health, the National Science Foundation, and other government agencies. Regarding transmission lines specifically, I served on a Scientific Advisory Panel convened by the Minnesota Environmental Quality Board to review health aspects of a high-voltage transmission line. In addition, I have served as a consultant on transmission line health and safety issues to the Vermont Department of Public Service, the New York State Department of Environmental

Conservation, the staffs of the Maryland Public Service Commission and the Maryland Department of Natural Resources, and the province of Prince Edward Island, Canada. I also have worked with the National Institute of Occupational Health and Safety, the Oak Ridge National Laboratories, the U.S. Department of Energy, and the Federal Railroad Administration to review and evaluate health issues related to electric and magnetic fields from other sources. I also assisted the U.S. EMF Research and Policy Information Dissemination ("RAPID") Program to evaluate biological and exposure research as part of its overall risk assessment process.

Internationally, I have worked with scientists from the World Health Organization ("WHO") on EMF risk assessment and the International Agency for Research in Cancer ("IARC"), a division of the WHO located in Lyon, France, in the review of possible hazards from exposures to static and extremely low frequency EMF. Most recently, I was an advisor to the ZonMw – Netherlands Organization for Health Research and Development on their National Programme on EMF and Health and the Federal Office for Radiation Protection in Germany on health and safety issues relating to EMF from new proposed transmission lines.

Q. What are electric and magnetic fields?

A. Electric and magnetic fields associated with the operation of alternating current power lines or devices are often referred to as EMF. Voltage, which is similar to 'pressure,' moves the electricity through wires and produces an electric field. The standard unit for measuring the strength of an electric field is volts per meter (V/m). Current, which is a

measure of how much electricity is flowing, produces a magnetic field. The unit in which magnetic field levels are measured is milligauss (mG). Both electric fields and magnetic fields are characterized by the frequency at which their direction and magnitude oscillate each second. The fields produced by the use of electricity in North America oscillate at a frequency of 60 cycles per second (60 Hertz [Hz]). The strength of both electric fields and magnetic fields decrease relatively quickly with distance from their source.

Q. What are typical sources of 60-Hz electric and magnetic fields?

A. Typical sources of these fields include power lines (both transmission and distribution lines), home and office appliances, tools, building wiring, and current flowing on water pipes. The contribution of these sources to overall exposure varies considerably. For example, if a residence is very close to a transmission line, or even a distribution line (which runs near most everyone's residence), these sources could be the dominant, but not necessarily the only, source of magnetic fields in the home. Depending on the circumstances, other sources may be of equal or greater importance. For example, a random survey of nearly 1,000 residences in the United States reported that currents flowing on water pipes and on other components of grounding systems are twice as likely as outside power lines to be the source of the highest magnetic fields measured in homes (Zaffanella, 1993).

Q. Please describe the research you have conducted concerning exposure to electric and magnetic fields.

A. I have studied and conducted research on EMF for over 30 years. My research has included laboratory studies, exposure assessment and dosimetry studies, and epidemiology studies of EMF across a range of frequencies, including those associated with power systems.

Q. Have you published or presented your research in this and other areas to the scientific community?

A. Yes. I have published or presented more than 50 scientific papers and technical reports on this and related subjects.

Q. Are you a member of any professional organizations?

A. I am a member of The Rockefeller University Chapter of Sigma Xi, a national scientific honor society; the Health Physics Society; the International Committee on Electromagnetic Safety, Subcommittees 3 and 4 – Safety Levels with respect to Human Exposure to Fields; the Bioelectromagnetics Society; the IEEE Engineering in Medicine and Biology Society; the Conseil International des Grands Reseaux Electriques; the American Association for the Advancement of Science; the New York Academy of Sciences; the Air & Waste Management Association; the Society for Risk Analysis; and the International Society for Exposure Analysis.

Q. Is your educational and professional experience summarized elsewhere?

A. Yes. Additional details of my educational and professional experience are summarized in my curriculum vitae, which is attached to this testimony as Attachment WHB-1.

Q. Have you previously testified before Rhode Island's Energy Facility Siting Board ("EFSB") or the Public Utilities Commission?

A. Yes, on several occasions. Most recently, I testified before the EFSB on EMF issues relating to the Interstate Reliability Project (Docket SB 2012-01).

Scope of Testimony

Q. What is the purpose of your testimony?

A. The primary purposes of my testimony are to introduce Exponent's review and summary of the status of health research regarding EMF exposure as required by EFSB Rules[1], and to present the calculations of EMF associated with the operation of existing and proposed transmission lines along the route of the Aquidneck Island Reliability Project (AIRP) and calculations associated with the proposed new Jepson Substation. Exponent's summary of the current status of research on EMF health effects was filed as Appendix B to National Grid's filing with the EFSB.[2] A copy is attached to this testimony as Attachment WHB-2. The calculations of electric and magnetic fields before and after the Project are included in Tables 7-10 through 7-12 and Tables 8-1 through 8-3 of the Environmental Report.

[1] EFSB. Rules of Practice and Procedures. 1.6, b, 12,.April 11, 1996

[2] Exponent. Current Status of Research on Extremely Low Frequency Electric and Magnetic Fields and Health: Rhode Island Transmission Projects – The Narragansett Electric Company d/b/a National Grid. March 9, 2015 (Appendix B to Environmental Report).

Q. What changes to the transmission system were modeled?

A. Exponent modeled the magnetic-field levels associated with the proposed Jepson Substation equipment, including breakers, transformers, buswork, and the interconnections of two 115 kV transmission lines (61 and 62 Lines) and one 69 kV transmission line (63 Line). Magnetic field levels were calculated for the both 2018 annual average/shoulder peak load and 2018 peak load conditions. R.G. Vanderweil Engineers, LLP ("Vanderweil") modeled the electric and magnetic-field levels for the 61 and 62 Lines for annual average and peak load for 2018 pre-construction, 2018 post-construction, and 2023 post-construction.

Q. What will be the effect of the proposed changes to the transmission system as a result of the Project described above on the EMF levels compared to the pre-construction EMF levels produced by existing transmission lines?

A. EMF levels for pre- and post-project conditions were modeled by Vanderweil for a portion of the route with existing single-circuit H-frame structures (Section 1) and a portion of the route with existing double-circuit 3-pole structures (Section 2). Each Section was modeled with and without a distribution line in the ROW. The change to a vertical alignment and the increased voltage resulted in a reduction of the magnetic-field levels at annual average loading ("AAL"). In particular, modeled magnetic fields on the west edge of the ROW from the existing transmission and distribution line configurations at 2018 AAL range from 38.1 mG to 39.7 mG . These modeled magnetic fields decline to ≤6.8 mG for post construction along the entire route in years 2018 and 2023.

Similarly, the modeled magnetic fields on the east edge of the ROW under 2018 AAL from the existing structures range from 30.9 to 40.1 mG, and decline to ≤10.4 mG and to ≤25 mG, respectively for sections of the route without and with distribution lines in years 2018 and 2023 post construction. Exponent also calculated the magnetic field levels at the substation fence line of the proposed Jepson Substation. The calculated levels are 2.1 mG or less at the fence surrounding the substation except where the transmission and distribution lines enter and leave the property.

Q. Were magnetic fields also calculated at other forecasted line loadings?

Yes. Magnetic-field levels also were calculated at expected annual peak loading ("APL") in 2018 (pre-construction), 2018 (post-construction) and 2023 (post-construction). The AAL is emphasized here because it provides the best estimate of 'typical' potential magnetic-field exposures on any randomly selected day of the year. When peak load demand occurs, for a limited time during the year (a few hours on a few days), the modeled magnetic fields are higher. At annual peak loadings, the levels of the magnetic field at the edges of the ROW are higher both pre- and post-construction but the reductions in the magnetic field after construction are similar in magnitude at APL to that projected at AAL.

Q. Will the rebuilt and upgraded 115 kV lines lead to an increase in the electric fields?

A. No, on the contrary, after construction the levels of the electric fields at both the west and east edges of the ROW are reduced from 0.33-0.48 kV/m to 0.11 kV/m on sections without distribution lines and to ≤0.15 kV/m for sections with distribution lines.

Q. Will the proposed new Jepson Substation lead to an increase in the electric fields?

A. The metal enclosures around some equipment and the conductive fence surrounding the substation will effectively block the electric field from the substation equipment. As with the magnetic fields, where overhead lines enter the substation the electric fields increase but the level post-construction will be less than from the existing lines.

Q. Are there any Rhode Island or federal standards that address EMF from transmission lines based on health considerations?

A. No state or federal standards have been enacted to limit exposure to EMF based on any finding that EMF have health effects. Years ago, two states, Florida and New York, enacted standards to limit magnetic fields from transmission lines at the edge of the ROW to maintain the "status quo" so that fields from new transmission lines would be no higher than fields produced by existing transmission lines. These limits are 200 mG (for 500-kV lines), 150 mG (for ≤230 kV lines) and 2 kV/m (≤500-kV lines) in Florida, and 200 mG and 1.6 kV/m in New York (FDEP, 1993; NYPSC, 1978; NYPSC, 1990).

Q. Have any international agencies or other organizations recommended EMF exposure limits based on established effects on human health and safety?

A. Yes, like anything else, as the level of exposure increases, adverse effects can be observed. At very high EMF levels, acute stimulation of nerves and muscles can result. Two international scientific organizations have published guidelines for exposure to EMF to protect against such effects. The International Commission on Non-Ionizing Radiation

Protection ("ICNIRP") recommends screening values[3] of 2,000 mG and 4.2 kV/m for the public in the past (ICNIRP, 2010). The 28 member countries of the European Union apply the ICNIRP recommendation "to relevant areas where members of the public spend significant time" (CEU, 1999).

The International Committee on Electromagnetic Safety ("ICES") also recommends limiting EMF exposures at high levels to prevent acute effects, although their guidelines are higher than ICNIRP's guidelines at 60 Hz. The ICES recommends public exposure screening values of 9,040 mG and 5 kV/m (ICES, 2002). These agencies have set these screening values and the underlying basic restrictions on internal electric fields far below exposure levels at which neurostimulatory effects might occur to account for uncertainty and variation in possible responses.

Q. Please summarize the conclusions of the survey of current health research which Exponent prepared (Appendix B to the Environmental Report and Attachment WHB-2 hereto.)

A. Our 2015 report presented a systematic literature review and a critical evaluation of epidemiology and *in vivo* studies published after the WHO report in 2007. The studies reviewed did not provide sufficient evidence to alter the basic conclusion of the WHO: the research does not suggest that electric fields or magnetic fields are a cause of cancer or any other disease at the levels we encounter in our everyday environment.

[3] Exposures above the screening values are permitted if the underlying current density or electric field within critical tissues, i.e., the basic restriction, is not exceeded.

Q. Since the date of the Exponent review in 2015, have there been major new studies or reviews published that would prompt you to revise its conclusions?

A. The most recent review of the literature is still the SCENIHR (2015) discussed in this review. As in other areas of science, research in this field is ongoing, but there have been no major new developments. Some notable studies that appeared include epidemiologic studies of childhood cancer published from California (Crespi et al., 2016), the United Kingdom (Bunch et al., 2015, 2016), and studies of neurodegenerative diseases from Sweden (Fischer et al., 2015), the Netherlands (Koeman et al., 2015; Brouwer et al., 2015) and the United States (Vergara et al., 2015). The large epidemiologic study of childhood cancer in California reported by Crespi et al. (2016) included 5788 childhood leukemia cases and 3308 childhood brain cancer cases. The authors reported no statistically significant associations for any of the cancer outcomes with residential proximity to high-voltage overhead power lines (60 kV to 500 kV). The British researchers provided updated analyses to their earlier studies discussed in the Exponent report. The new analyses provided no support for an association for any of the investigated childhood cancers with either distance or estimated magnetic field levels. The Swedish (Fischer et al., 2015) and U.S. (Vergara et al., 2015) studies reported results of a population-based case-control study of occupational exposure to electric shocks and magnetic fields and amyotrophic lateral sclerosis ("ALS"). Overall, neither of the two studies reported an association between EMF and ALS. Brouwer et al. (2015) and Koeman et al. (2015) examined the occurrence of Parkinson's disease and dementia in a

cohort of 120,000 followed for almost 30 years. No statistically significant trends or consistent associations were reported for any of the reported outcomes in association with estimated occupational EMF exposure. Overall, the results of these and other recently published studies do not change the overall assessment and conclusions expressed in the WHO and SCENIHR reports.

Q. Has National Grid continued its approach to minimize the potential for greater EMF exposure from this Project consistent with recommendations of the U.S. National Institute of Environmental Health Sciences (NIEHS, 2002) and the WHO (2007a, 2007b)?

A. Yes. National Grid has proposed to rebuild and upgrade existing transmission lines on an existing ROW at a higher voltage to minimize the areal spread of EMF in the area and also proposed to optimize the phasing configuration of the upgraded lines to minimize the fields outside the ROW by promoting the mutual cancellation of fields from the lines.

Q. Are you familiar with the advisory opinion to the EFSB from the Rhode Island Department of Health on November 2, 2016 that commented on Exponent's report?

A. Yes, I am.

Q. Did the Department of Health recommend any modifications to the proposed project to minimize magnetic fields in addition to those already incorporated by National Grid into the project siting and design?

A. No, it did not. The Rhode Island Department of Health noted that the calculated levels of EMF were well below published guidelines for EMF exposure and that the project siting and design would reduce existing field levels at the edges of the ROW:

> *In the absence of national and local regulations regarding exposure to 60 Hz EMFs, these guidelines provide prudent parameters for planning new/modified electric transmission infrastructure."*
>
> *the proposed power line reconfiguration would decrease potential electric field exposures…. [and] that the proposed modification of the transmission lines on Aquidneck Island would reduce annual peak load magnetic field levels at the edge of the ROW . . . [to] levels are about two orders of magnitude lower than ICNIRP guidelines for exposure to the general public (2,000 mG)."* (RIDOH, 2016, p. 7)

Q. Does this conclude your testimony?

A. Yes.

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ATTACHMENTS

WHB-1 Curriculum Vitae of William H. Bailey, Ph.D.

WHB-2 Current Status of Research on Extremely Low Frequency Electric and Magnetic Fields and Health: Rhode Island Transmission Projects – The Narragansett Electric Company d/b/a National Grid. March 9, 2015 (Appendix B to Environmental Report).